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RW 2050 Revision 3

CGAT SLEEVING

SCOPE

This Quality Assurance Specification establishes the quality standard for a semi-flexible, electrically insulating, selectively cross-linked, dual wall, heat shrinkable sleeving.

Approved Signatories*

	<u>Quality Assurance</u>	<u>Technical</u>	<u>Product Management</u>
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* This document is electronically reviewed and approved by Tyco Electronics UK Approvers therefore no signatures will appear. Tyco Electronics USA approval signatures and records of Tyco Electronics USA approvals are maintained by the UK, RW Specification Document Controller.

1. REVISION HISTORY

Revision Number	Change Request	Date	Incorporated By
0	Formerly RK6148 Revn 2		
1	CRF T1020 CR98-DM-0030	27 August 1997 17 February 1998	C. Woosnam L. Abrams
2	CR05-DM-081	4 May 2005	L. Abrams
3	Via DMTEc	24 February 2014	C. Diss

2. REQUIREMENTS**2.1 Composition, Appearance and Colour**

The sleeving shall be homogeneous and essentially free from pinholes, flaws, bubbles, cracks, seams, defects and inclusions. The jacket colour shall be black or clear. The liner shall be amber.

2.2 Dimensions

Size	Inside Diameter as supplied (min) mm (in)	Inside Diameter after recovery (max) mm (in)	Wall Thickness after recovery mm (in)
Black			
3/1	3.0 (0.118)	1.0 (0.039)	1.00 ± 0.25 (.039 ± .010)
6/2	6.0 (0.236)	2.0 (0.079)	1.00 ± 0.25 (.039 ± .010)
9/3	9.0 (0.354)	3.0 (0.118)	1.35 ± 0.25 (.053 ± .010)
12/4	12.0 (0.472)	4.0 (0.157)	1.50 ± 0.25 (.059 ± .010)
18/6	18.0 (0.709)	6.0 (0.236)	1.70 ± 0.25 (.067 ± .010)
24/8	24.0 (0.945)	8.0 (0.315)	1.90 ± 0.25 (.075 ± .010)
39/13	39.0 (1.535)	13.0 (0.512)	2.10 ± 0.25 (.083 ± .010)
Clear			
3/1	3.0 (0.118)	1.0 (0.039)	1.00 ± 0.30 (.039 ± .012)
6/2	6.0 (0.236)	2.0 (0.079)	1.00 ± 0.30 (.039 ± .012)
9/3	9.0 (0.354)	3.0 (0.118)	1.40 ± 0.30 (.055 ± .012)
12/4	12.0 (0.472)	4.0 (0.157)	1.75 ± 0.40 (.069 ± .016)
18/6	18.0 (0.709)	6.0 (0.236)	2.25 ± 0.55 (.089 ± .022)
24/8	24.0 (0.945)	8.0 (0.315)	2.55 ± 0.55 (.100 ± .022)
39/13	39.0 (1.535)	13.0 (0.512)	2.55 ± 0.55 (.100 ± .022)

Sleeving of special expanded or recovered dimensions may be supplied as specified in the contract or order.

2.3 Test Requirements

The test requirements shall be as specified in Table 1.

3. TEST METHODS

3.1 Preparation of Test Specimen

Unless otherwise specified, tests shall be carried out on specimens of sleeving recovered by conditioning in a fan assisted air circulating oven at $200 \pm 5^\circ\text{C}$ for 4 ± 1 minutes and allowed to cool in air to ambient temperature. No pre-conditioning period is required prior to testing. Unless otherwise specified, all tests shall be made under standard ambient conditions according to IEC Publication 60212. In cases of dispute the tests shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$ and at $50 \pm 5\%$ relative humidity.

3.2 Dimensions and Longitudinal Change

The test method shall be as specified in ASTM D2671. The length and inside diameter of three 150mm long specimens of expanded sleeving shall be measured. The specimens shall be recovered in a fan assisted air circulating oven and the length and inside diameter of each shall be measured. The longitudinal change shall be expressed as a percentage of the original length. The minimum and maximum recovered wall thickness shall be determined.

3.3 Tensile Strength and Ultimate Elongation

The test method shall be as specified in ISO 37. Determine the Tensile Strength based on the cross-sectional area of the jacket only. Use suitable optical method (e.g. microscope) to measure the thickness of the outer wall for this calculation. For sleeving of recovered bore greater than 4mm, five Type 2 dumb-bell specimens shall be tested. For sleeving of recovered bore less than or equal to 4mm, five tubular specimens 125mm long shall be tested. Initial jaw separation shall be 50 mm and rate of jaw separation shall be 50 ± 5 mm per minute. The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$.

3.4 2% Secant Modulus

The test method shall be as specified in Method A of ASTM D882. For sleeving of recovered bore greater than 6mm, five strip specimens 150mm long shall be tested. For sleeving of recovered bore less than or equal to 6mm five tubular specimens 150mm long shall be tested. Initial jaw separation shall be 100mm and rate of jaw separation 10 ± 1 mm per minute. The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$.

3.5 Inner Wall Adhesion

The test shall be carried out on Size 39/13 CGAT. Five cylindrical rolling drum adhesion test mandrels 25mm long by 25mm diameter and of surface material as specified shall be cleaned and degreased. Specimens of Size 39/13 CGAT approximately 50mm long shall be recovered on to the mandrels by conditioning in a fan assisted air circulating oven at $150 \pm 3^\circ\text{C}$ for 20 minutes. After conditioning the specimens shall be removed from the oven and allowed to cool naturally to room temperature. Surplus lengths of CGAT shall be trimmed level with the ends of the mandrels. The specimens shall be slit axially and peeled from the mandrels in a suitable tensile testing machine such that the sleeving peels off at a rate of 50 ± 5 mm length per minute as the mandrel rotates. See Figure 1. The test shall be carried out at a temperature of $23 \pm 2^\circ\text{C}$. The mean peel-off force for each specimen shall be recorded, and the mean of the five recorded measurements reported as the Inner Wall Adhesion.

TEST METHODS (Cont'd)**3.6 Heat Shock**

The test method shall be as specified in ASTM D2671.
The specimens shall be conditioned in a fan assisted air circulating oven as specified in Table 1.

3.7 Heat Ageing

The test method shall be as specified in ISO 188.
For sleeving of recovered bore greater than 6mm, five strip specimens 75mm x 6mm, shall be tested. For sleeving of recovered bore less than or equal to 6mm, five tubular specimens 75mm long shall be tested. The specimens shall be conditioned in a fan assisted air circulating oven as specified in Table 1.

3.8 Low Temperature Flexibility

The test method shall be as specified in Procedure C of ASTM D2671.
The sleeving shall be tested in the as supplied state.
Mandrel diameter shall be 20 x specimen thickness $\pm 10\%$.
The specimens and mandrels shall be conditioned as specified in Table 1.

3.9 Flammability Rate (Black Only)

The test method shall be as specified in MVSS 302.

3.10 Electric Strength

The test method shall be as specified in IEC 60243 (short-time test).

3.11 Water Absorption

The test method shall be as specified in Method 1 of ISO 62.
For sleeving of recovered bore greater than 8mm, three disc specimens of diameter 25 ± 1 mm shall be cut from the sleeving. For sleeving of recovered bore less than or equal to 8mm, three tubular specimens 50mm long shall be cut from the sleeving.

3.12 Fluid Resistance

The test method shall be as specified in ISO 1817.
Five tensile test specimens prepared as in Clause 3.3. shall be completely immersed in each of the fluids for the times and temperatures specified in Table 1. The volume of the fluid shall not be less than 20 times that of the specimen. After immersion, lightly wipe the specimens and allow to air dry at $23 \pm 2^\circ\text{C}$ for $1\text{h} \pm 15\text{m}$. The Tensile Strength and Ultimate Elongation of each specimen shall be tested according to Clause 3.3. The test shall be repeated on the remaining specified fluids.

4. RELATED STANDARDS & issue

ASTM D882-02	Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
ASTM D2671-00	Standard Test Methods for Heat-Shrinkable Tubing for Electrical Use
IEC 60212: 1971	Standard Conditions for Use Prior to and During Testing of Solid Electrical Insulating Materials
IEC 60243-1: 1998	Electrical Strength Of Insulating Materials - Test Methods - Tests At Power Frequencies
ISO 37: 1994	Rubber, vulcanized or thermoplastic - Determination of Tensile Stress-Strain Properties
ISO 62: 1999	Determination of Water Absorption
ISO 188: 1998	Rubber, vulcanized - Accelerated Ageing or Heat Resistance Tests.
ISO 1817: 1999	Rubber, vulcanized - Determination of the effect of liquids
MVSS 302: 1975	Flammability of Materials - Passenger Cars, Multiple Passenger Vehicles, Trucks and Buses (Docket N. 3-3;Notice 4)

Subsequent amendments to, or revisions of, any of the above publications apply to this standard only when incorporated in it by updating or revision.

5. SAMPLING

Tests shall be carried out on a sample taken at random from each batch of finished sleeving. A batch of sleeving is defined as that quantity of sleeving extruded at any one time. Testing frequency shall be Production Routine or Qualification. Production Routine tests consisting of Visual Examination, Dimensions, and Longitudinal Change shall be carried out on every batch of sleeving.

Qualification tests shall be carried out to the requirements of the Design Authority.

6. PACKAGING

Packaging shall be in accordance with good commercial practice. Each package shall bear an identification label showing material quantity, description, size, colour and batch number. Additional information shall be supplied as specified in the contract or order.

FIGURE 1 - Peel Specimen in Tensile Tester

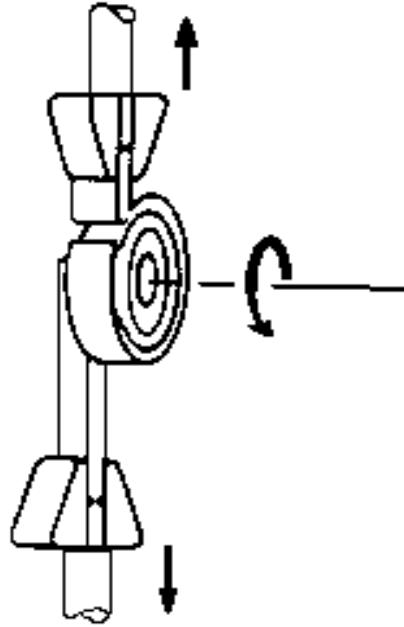


TABLE 1 Test Requirements

Test	Test Method	Test Requirements
Visual Examination	-	As per Clause 2.1
Dimensions	ASTM D2671	As per Clause 2.2
Longitudinal Change	ASTM D2671	0 to -15%
Tensile Strength	ISO 37	9.0 MPa minimum
Ultimate Elongation	ISO 37	200% minimum
Secant Modulus at 2% strain	ASTM D882	125 MPa maximum
Inner Wall Adhesion - CGAT to Aluminium	Clause 3.5	60N /25mm minimum
Heat Shock (4h ± 15m at 150 ± 5°C)	ASTM D2671	No dripping, cracking or flowing of outer wall
Heat Ageing (168 ± 2h at 125 ± 3°C)	ISO 188	No dripping, cracking or flowing of outer wall
Low Temperature Flexibility (4h ± 15m at -55 ± 2°C)	ASTM D2671	No cracking
Electric Strength	IEC 60243-1	12 MV/m minimum
Flammability Test Burning Rate (Black Only)	MVSS 302	100 mm/minute maximum
Water Absorption (24 ± 2h immersion at 23 ± 2°C)	ISO 62	0.5% maximum
Fluid Resistance 24 ± 2h immersion at 23 ± 2°C • Gasoline Fuel to ISO 1817 Test Liquid B • Engine Oil to SAE 20W/50 • Hydraulic Fluid to SAE J1703 - Tensile Strength - Ultimate Elongation	ISO 1817 ISO 37	5 MPa minimum 200% minimum

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